

**Before the
Federal Communications Commission
Washington, D.C. 20554**

In the Matter of)
)
IP Enabled Services) WC Docket No. 04-36
)

Comments of Inclusive Technologies

Inclusive Technologies¹ respectfully submits its Comments to the Commission pursuant to the Docket Item referenced above.

Introduction and Summary

We are pleased to offer comments to the Commission on its NPRM. We will restrict our comments to Voice over Internet Protocol (VoIP) rather than take on the larger issue of all IP enabled services. We will comment on VoIP's regulatory status and its accessibility. We gratefully acknowledge the assistance of Gunnar Hellstrom of Omnitor in providing some material, but we take full responsibility for its use and our recommendations.

Our views on the regulatory classification of VoIP, briefly, are these:

First, VoIP is simply a voice telecommunications service.

¹ Inclusive Technologies provides consulting services in telecommunications and disability, aging, and education. Our technical services include analyses of existing products, assistance with service and product development and deployment, technology scans, and technical development of prototypes. Other services provide assistance with business practices: primary and secondary market research and analysis, customer surveys, focus groups, product trials, product management, strategic partnership development, staff training, internal team-building, and consumer and other stakeholder liaison. We provide these services to information technology companies, regulatory agencies, and consumer advocacy organizations. Inclusive's clients include the Access Board, the American Foundation for the Blind, the California Deaf and Disabled Telecommunications Program, Computer Professionals for Social Responsibility, HP, IBM, Microsoft, the National Institute on Disability and Rehabilitation Research, the New York City Public Schools Commissioner's Office, the New York State Diffusion Fund, Panasonic, Qualcomm, Nortel, SBC Communications, Verizon, and Xerox. Inclusive Technologies performed a Market Monitoring Report for the Access Board, a snapshot of the state of the art of accessible telecommunications. The Report includes a description of the access features found on a wide range of telecom products, and a searchable database of over 600 specific models, for use by designers, engineers, regulators, and consumers with disabilities. Inclusive Technologies maintains a website on VoIP accessibility: <http://www.inclusive.com/trng/voip>.

Second, **VoIP exists in several implementations with different accessibility and regulatory implications.**

Third, VoIP challenges conventional regulatory frameworks, but **effective and efficient Section 255 regulation is feasible.**

Our views on the accessibility of VoIP, briefly, are these:

First, **VoIP impacts people with disabilities now.**

Second, **VoIP has specific positive and negative access implications.**

Third, **most potential VoIP accessibility barriers are technically resolvable.**

Fourth, **the most critical barriers regarding VoIP accessibility are informational**, not technical, and these apply both to users and industry.

Finally, we make certain **recommendations to the Commission** regarding accessibility regulations.

Regulatory Classification

VoIP is a Voice Telecommunications Service

The Commission has been accustomed to using a jurisdictional distinction between telecommunications services and information services. Briefly², the latter consists of services in which information is stored or altered in form or content, while the former does not.

However, several Internet-based services appear to blur this distinction. The range of services, and moreover the multiplicity of entities whose products consist in facilitating only part of each service, and who have no formal business relationships must tend to confuse the Commission, as it confuses consumers.

However, amidst this confusion, there should be some simple clarity. We would assert that **any service that involves immediate, intentional real-time exchange of information** between two or more parties, without either alteration of that information in form or content or access to stored information, **cannot be an information service**. Unless there is another category, such a service would appear to be a telecommunications service, regardless of the facilities used to provide the service. Although the Internet

² We do not intend to present a full discussion of the distinction between telecommunications services and information services. We only wish to put forward a common sense lay position based on our imperfect understanding of telecommunications law, and we apologize in advance for any errors in our argument.

began as a means of transporting stored information – email and files – it has since accepted many other forms of information, among them VoIP, that do not involve storage.

VoIP meets the telecommunications service criteria.

1. There is no alteration of content, as the voice traffic from each side is reproduced as exactly as possible at the other end.
2. There is no storage of the content for later retrieval, only temporary buffering for transmission purposes when necessary, which almost always occurs at the terminating CPE.
3. The communication is point-to-point.
4. The communication's origination and destination are chosen by the users.

Moreover, a service or product that is designed and marketed expressly to replicate the functionality of a telecommunications service or product should be considered regulatorily identical to the service or product it is emulating. This is especially true if the service or product's **sole** function is to replicate the telecommunications service or product. Everything about VoIP meets this criterion. Any other interpretation would establish an unfair competitive disparity between services and products with identical functionalities.

Stated another way, just because a telecommunications service is carried over a network (the Internet) that also carries information services (email, web pages, etc.) does not convert the telecommunications service into an information service.

VoIP Has Several Implementations With Different Regulatory and Accessibility Implications

One cause of some regulatory confusion may be that VoIP is not one product or service; it has many facets. Different parts of the telecom industry (manufacturers, carriers, software developers, system integrators, etc.) play different roles in VoIP implementation. The different implementations can either extend or restrict telecom accessibility, as shown in the table below.

TABLE 1: VOIP IMPLEMENTATIONS

	Definition	Negative Implication	Positive Implication
Network Segment	VoIP is used in a transmission facility for a portion of a PSTN, but calls begin and end on circuit-switched network segments. The FCC has already	"VoIP segment insertion" is unknown to and uncontrolled by the end user so accommodation is not possible; TTY performance and audio quality may be degraded.	Lower cost to carriers may result in less expensive service.

	Definition	Negative Implication	Positive Implication
	ruled that this is a telecommunications service, and therefore regulated.		
PBX	VoIP is used as the only protocol within a private network (owned and managed by an organization such as a company, municipality, university, etc.). The PBX is connected to the public network.	<p>The management of the organization purchasing the PBX may not consider needs of users with disabilities.</p> <p>PBX selected by the organization may lack important accessibility features.</p> <p>The organization may administer the PBX so as to limit its accessibility.</p> <p>Employees with disabilities may not be able to choose accessibility solutions (for example, if the PBX uses only inaccessible proprietary phones).</p> <p>Inaccessibility may affect both employees and callers from PSTN.</p>	Voice and data integration may allow improved accessibility within organization and to external callers, such as unified voice and text messaging, TTY gateway.
Hardware	Device designed to be used for VoIP calls, including phones, adapters, and routers	Phones may have been designed without attention to the accessibility of physical controls, TTY connectability, and displays	
PBX softphones	Software that emulates a PBX phone's functionality, sometimes integrated with related applications such as email and instant messaging.	Softphones available for any given PBX may not be accessible.	<p>Some softphones are highly compatible with assistive technologies.</p> <p>Some softphones have their own screen reading capability.</p>

	Definition	Negative Implication	Positive Implication
			Hard of hearing users can select audio output devices and adjust them for optimal use.
Internet peer-to-peer softphones	A softphone intended for a PC user to place and receive direct VoIP calls over the Internet, without a carrier.	Profusion of softphones may complicate finding one with the accessibility features needed by any given individual.	<p>Low cost telecom service.</p> <p>Profusion of softphones may provide a wide range of accessibility features.</p> <p>Hard of hearing users can select audio output devices and adjust them for optimal use.</p>

Effective And Efficient Section 255 Regulation of VoIP Is Feasible

As mentioned in the table above, the Commission has already ruled that inserting a VoIP segment into the PSTN does not change the regulatory status of the network. This ruling is consistent with the regulatory status of any other such conversion in a transmission facility, (e.g. analog to digital and back again) as long as the content of the communication traffic is not stored or altered.

We recognize that some of the implementations listed in the table above challenge conventional definitions. Yet it is clear to us that as far as Section 255 is concerned, they are all able to be effectively and efficiently regulated. That is, we believe that imposing Section 255 regulations will not overly tax the resources of the Commission, nor will it impose an excessive burden on industry. It is important to keep in mind that Section 255 requires companies only to perform accessibility activities to the extent that they are “readily achievable”.

It is also important to recognize that VoIP, as a transmission protocol, is irrelevant to the provisions of Section 255, which concerns itself with the user interface, not the means of transmission. That is, Section 255 concerns itself with how the user controls the product or service, and how the user accesses the content of the communication. We have reviewed the relevant provisions of the Section 255 Rules with particular attention as to whether there are any special implications for VoIP. We can find none.

It Is Necessary to Apply Section 255 Regulations to VoIP Software

In some cases, especially where a hardware telephone is replaced by a softphone, some may argue that Section 255, intended and designed principally for TE, CPE, and network services, should not be applied to software. However, the Commission's position is clear on this issue. The Section 255 Rules adopted by the Commission explicitly include "software integral to the equipment's operation" in CPE (Sections 12, 83). Furthermore, even software "sold separately" that "originates, terminates and routes telecommunications should be deemed 'equipment' under the CPE definition" (83). The Commission further made it clear that even equipment (such as a PC) that is not designed as CPE but can perform the functions of CPE when certain software is installed in it, must be considered CPE: "customer premises equipment is covered by section 255 only to the extent that it provides a telecommunications function. Specifically, equipment that generates or receives an electrical, optical or radio signal used to originate, route or terminate telecommunications is covered, even if the equipment is capable of providing non-telecommunications functions" (87).

Clearly, any computer under consideration would be judged as CPE even without VoIP software, as they are almost universally equipped with:

- either a modem or network hardware, or both
- audio hardware for input, output, and digital processing
- operating system support for CPE functions, such as TAPI and configuration utilities

We agree with the Commission's categorization of software within CPE, and do not expect to see any problems arising from its extension to VoIP.

The Commission also made clear that it understands that many telecom software companies are small firms, but still must be regulated under Section 255. In its "Final Regulatory Flexibility Analysis" of the Section 255 Report and Order, the Commission states in "C.2. Software Manufacturers" that as many as 500 small business were "involved in the production of software specific to telecommunications". We feel that this was a generous estimate in the year in which it was made (1999). Given the mergers and acquisitions in the software industry since that date, we do not believe that this number has grown, even with the addition of firms specializing in VoIP software. If the Commission believed that its rules were not burdensome to small businesses in 1999, the regulations should be extended to the equal or smaller number of firms now active, especially keeping in mind the "readily achievable" protection those firms would receive. We believe that the small business estimate in the current NPRM, which reflect all companies active in IP-enabled services, is too large. In any event, we believe that by confining the subject to VoIP, there are no more than 500 software firms that may be affected.

Inaccessible VoIP Jeopardizes People with Disabilities Now

The accessibility of VoIP is important to people with disabilities. The barriers faced by people with disabilities are not theoretical issues; they are already affecting social integration and equality, due to the rapid adoption of VoIP. Here are some examples:

- the default peer-to-peer software application distributed by one of the most popular VoIP service providers is completely incompatible with screen readers and provides no support for screen magnification utilities
- another popular VoIP service requires users to perform a visual test in order to register; this test is not accessible to blind or low vision users, and no accommodation is provided
- one VoIP phone is controlled entirely by a single touchscreen; this is not accessible to people with visual or dexterity impairments
- TTY performance on many VoIP systems is significantly worse than the standard now used for permissible character error rate, 1%
- almost no system administration documentation for VoIP PBXs shows any reference to accessibility
- almost no VoIP companies refer to accessibility in any of their consumer information or indicate an accessibility point of contact

Inaccessible VoIP jeopardizes their full integration at five points:

- As **employees**, if employers adopt VoIP implementations that are not accessible
- As **entrepreneurs**, if the telecommunications tools required for their businesses are not accessible
- As **residential customers**, if the VoIP offerings are better in quality or lower in price³ than traditional voice telecom offerings
- As **students**, if educational institutions adopt, as part of their curricula, VoIP implementations that are not accessible
- As **citizens**, if government agencies adopt, as their method of communicating with the public, VoIP implementations that are not accessible

Although the transport of TTY traffic over VoIP is the most commonly mentioned concern, it is not the only one:

- People who are hard of hearing may not be able to use VoIP if the voice quality is significantly worse than conventional telephony
- Similarly, people with speech impairments or people who use voice-output communication aids may not be as intelligible to the other party if the voice quality is significantly worse than conventional telephony
- People who have low vision may not be able to use the VoIP software on-screen controls if those controls are not designed to be visually accessible

³ Many integrated VoIP offerings are clearly less expensive than other real-time voice communication options, and are marketed as such.

- People who are blind or have extremely low vision may not be able to use the VoIP software on-screen controls if those controls are not compatible with their screen access systems
- People with mobility limitations may not be able to use the VoIP software on-screen controls if those controls require keyboard or mouse actions that are not easy for them to perform, or if the controls are not compatible with their alternate input systems
- People with language or cognitive impairments may not be able to use the VoIP software on-screen controls if those controls are not simple enough to understand

As has happened many times before, people with disabilities are faced with a two-edged sword: rapidly advancing technology that may further exclude them from public life, or offer them new pathways into full participation.

The table below shows for each Section 255 Guideline (the rows) whether there is a potential barrier in VoIP hardware, software, or networks. In most cases there is a direct comparison between current conventional telephony and VoIP.

TABLE 2: VOIP ACCESSIBILITY BARRIERS

Sec. 255 Guideline ⁴	Short description	Barriers Specific to VoIP That Are Rare or Absent in "Conventional" Telephony
1193.33(a)	Product documentation and customer support	The smaller, Internet- or software-oriented firms involved in some VoIP implementations may ignore business-to-consumer relationship.
1193.33(b)	Accessibility point of contact	Smaller, internet- or software-oriented firms may ignore business-to-consumer relationship.
1193.33(c)	Employee training	Smaller, internet- or software-oriented firms may lack significant employee training programs.
1193.37	Pass-through of codes/formats	TTY signal compatibility is known to be jeopardized in some implementations.
		Captioning and video description of videoconferencing may be jeopardized in some implementations.
		Not all routers or networks permit VoIP or IP multimedia
1193.41(a)	Operable without vision	Some VoIP softphones are not compatible with screen readers.
		Some VoIP hardware phones rely on hardware displays and softkeys with contextual meanings.
		At least one VoIP hardware phone model uses a single large touchscreen for operation.
1193.41(b)	Operable with low vision and limited or no hearing	Some VoIP hardware phones have small or hard to read displays.

⁴ We use the Access Board numbering here for clarity.

Sec. 255 Guideline⁴	Short description	Barriers Specific to VoIP That Are Rare or Absent in "Conventional" Telephony
1193.41(c)	Operable with little or no color perception	No VoIP-specific barriers ⁵
1193.41(d)	Operable without hearing	No VoIP-specific barriers
1193.41(e)	Operable with limited manual dexterity	Some VoIP hardware phones have hard-to-use controls, including touchscreens.
1193.41(f)	Operable with limited reach and strength	No VoIP-specific barriers.
1193.41(g)	Operable without time-dependent controls	No VoIP-specific barriers.
1193.41(h)	Operable without speech	No VoIP-specific barriers.
1193.41(i)	Operable with limited cognitive skills	Managing softphone installation and configuration may be hard to understand. Arranging for peer-to-peer service is complex. Some VoIP softphones have graphics-rich screens that may be hard to understand.
1193.43(a)	Availability of visual information	Some VoIP PBXs do not provide an audible method of delivering visual information. Some VoIP hardware phones have small or hard to read displays. Some VoIP softphones are not compatible with screen readers.
1193.43(b)	Availability of visual information for low vision users	Some VoIP softphones have graphics-rich screens that may be hard to navigate through and read. Some VoIP softphones are not compatible with screen magnifiers and high contrast settings.

⁵ Note: The entry "no VoIP-specific barriers" in this table does not mean that VoIP is automatically accessible or conformant to that Sec. 255 Guideline. It only means that there is nothing unique to VoIP as a platform; many barriers continue to exist in "conventional" telephony as experienced by average users with disabilities.

Sec. 255 Guideline⁴	Short description	Barriers Specific to VoIP That Are Rare or Absent in "Conventional" Telephony
1193.43(c)	Access to moving text	Some VoIP softphones use moving text methods that are not compatible with screen readers.
1193.43(d)	Availability of auditory information	Some VoIP PBXs do not provide a visual method of delivering audible information.
1193.43(e)	Availability of auditory information for people who are hard of hearing	Reduction in audio quality may reduce intelligibility. Loss of synchronization between audio and video in IP videotelephony reduces their intelligibility during speech-reading.
1193.43(f)	Prevention of visually-induced seizures	No VoIP-specific barriers.
1193.43(g)	Availability of audio cutoff	VoIP hardware phones without a separate headset jack cannot implement cutoff.
1193.43(h)	Non-interference with hearing technologies	Softphone use on a PC may cause additional interference.
1193.43(i)	Hearing aid coupling	No VoIP-specific barriers.
1193.51(a)	External electronic access	No VoIP-specific barriers.
1193.51(b)	Connection point for external audio processing	Many VoIP hardware phones have no separate headset jack.
1193.51(c)	Compatibility of controls with prosthetics	Touchscreens on some VoIP hardware phones may not be compatible with prosthetics.
1193.51(d)	TTY connectability	Many VoIP hardware phones have no way to connect a TTY.
1193.51(e)	TTY signal compatibility	TTY signal compatibility is jeopardized in some implementations.

We explicitly draw attention to barriers that are “rare or absent in conventional telephony” for a reason. We believe that if accessibility regulations are not forcefully extended to VoIP, users with disabilities will be subjected to a serious net loss of accessibility as their employers, educational institutions, and the telecom market as a whole migrates to VoIP.

VoIP Offers Opportunities for Improved Access to Telecommunications

It may appear that we are opposed to VoIP because of its current inaccessible implementations. This is not the case. There have been several noteworthy attempts not only to make the basic service accessible, but to use the platforms that support VoIP to support integral or parallel services and features that would be of tremendous benefit to users with disabilities. VoIP potentially offers all the access opportunities that computer technology does in general, plus some synergistic opportunities unique to the communication needs of people with disabilities. For example:

- Intelligent packet buffering can provide improved TTY compatibility on the incoming side, as the software can respond to network congestion, jitter, and packet loss by adjusting its Baudot decoding performance and making informed guesses about characters
- Audio processing can improve incoming voice quality by interpolation and frequency shifting; processing can be driven by the user's unique audiological requirements
- Users can receive redundant control information using their preferred combination of visible and audible output⁶
- Users can control the interface with the same system they use to control other computer applications, such as speech recognition and keyboard/mouse emulation
- VoIP service can be configured to each user's needs automatically, including input/output preferences, automatic routing of calls, and intelligent directory-based dialing
- VoIP offers integration with other forms of electronic communication (voice mail, email, chat, etc.) that may be usable by and attractive to some people with disabilities
- VoIP offers integration with and substitution for these same forms of electronic communication when they pose a barrier to some people with disabilities
- VoIP offers several opportunities for improved and less expensive telecommunications relay service (TRS)

Many of these access features may not need to reside in the VoIP software itself, but as part of the VoIP service "pipeline." That is, the VoIP software would manage the establishment of calls and the transmission of packets, but might receive commands and pre-processed audio input from another application, or deliver audio output to another application for further processing. In order for these applications to interoperate, both sides must guarantee compatibility.

The table on the next page lists some enhancements by disability category.

⁶ One way of doing this is through the use of "skins", the flexible interfaces now found as a part of some computer applications. Skins allow users to alter the size, graphical content, and font of the application, much the way that style sheets or themes do with web pages.

Here is a table of the potential accessibility opportunities for VoIP, with applications in the rows and disability categories in the columns.

TABLE 3: VOIP ACCESSIBILITY OPPORTUNITIES

	Deaf	Hard of Hearing	Blind	Low Vision	Speech Impaired	Dexterity Impaired	Cognitively Impaired
Integrated, simultaneous voice, text, and video communication, wired and wireless	Sign language communication Voice carryover and video relay are easier to set up and use Captioned video-conferencing	Speech-reading Captioned video-conferencing			Hearing carryover is easier to set up and use Improved Speech-to-Speech using video	Wireless improves ease of use	Multiple media makes communication more compelling and intelligible
Integration with IP-relay (TRS)							
Wideband audio ("face-to-face" audio quality)		Improved intelligibility			Improved intelligibility		
Full-featured two-way simultaneous text communication (full screen, fonts, emoticons, etc.)	Easier to use, more expressive than TTY				Easier to use, more expressive than TTY Easy to prepare utterances in advance, insert into		

	Deaf	Hard of Hearing	Blind	Low Vision	Speech Impaired	Dexterity Impaired	Cognitively Impaired
					message		
User profile automatically establishes individual preferences and network services (transcoding, relay, text macros, speech synthesis, etc.)	Easier to set up	Easier to set up	Easier to set up	Easier to set up	Easier to set up	Easier to set up; reduces physical effort	Easier to set up; reduces mental effort Buddy list simplifies use
User profile and account information can be used on multiple devices (home, work, and wireless phone) and public terminals with "follow me" service			Easier to set up Skip steps on visual terminals	Easier to set up; skip steps on visual terminals		Easier to set up Reduces physical effort	Easier to set up Reduces mental effort
Multimedia emergency service	Improved access via text	Improved access via wideband audio			Improved access via wideband audio		Improved access by using video to explain emergency

We look forward to seeing these readily achievable enhancements in public VoIP offerings. (In fact, most of these enhancements have already been achieved in one form or another.)

VoIP Applications and Services Should Be Required to Meet Existing Accessibility Regulations

Inclusive Technologies believes that all VoIP products and services should be subject to all the provisions of Section 255 and other regulations.

Computer-based VoIP appears at first more complicated than regular phone service, because it involves the signal processing and data transmission capabilities of a computer. However, it is our experience that modern computer technology is not the principal barrier to accessible VoIP, because they no longer pose insurmountable barriers to other computer applications. Similarly, modern operating systems include several elements essential to placing and receiving telecommunications calls, but to our knowledge none of these elements by itself determines the accessibility or inaccessibility of those calls. Consumers with disabilities have become able to use computers largely because, due in part to the efforts of people with disabilities and disability-oriented developers and manufacturers, computer hardware and operating systems are so flexible, so ready to accept modification, and themselves contain many of the accommodation resources required by people with disabilities. The hardware and operating systems have moved from being primary barriers and now are primary enablers of access. It is in the applications that barriers now reside.

We believe that the Commission should use the state of the art of computer accessibility (and its constant advances) as the standard against which computer-based VoIP should be judged. In other words, a person who, with or without assistive technology, is able to use a computer to control audio sources (e.g. listen to CDs), should be able to control the audio of a VoIP call. If not, then the VoIP product and/or service has not met the relevant Section 255 Guideline for access to auditory information. The entity responsible for the software application, gateway, or server may be able to show that another element of the computer or any other necessary component not under their control is responsible for inaccessibility, and that there is no readily achievable solution. The same standard should be extended to the other functions of the VoIP product, such as access to controls, displays, etc.

This approach would put VoIP within the same two-tier framework as the other equipment covered by Section 255: build in accessibility if it is readily achievable; if not, build in compatibility if that is readily achievable.

VoIP Compliance with Section 255 Should Be Readily Achievable in Almost All Cases

We would like to express **our strong belief that VoIP technology can be made fully accessible with very little effort**. Aside from the TTY compatibility issue, all the access issues we raised above fall into four categories:

- Visual interface problems in software. There are abundant solutions for these, both within the design of the application interface (size, layout, font, contrast, etc.) and through the use of assistive technology products.
- Audio quality problems related to jitter and other IP artifacts. Here any improvements made would benefit not only people with hearing loss, but all users. The VoIP software companies are presumably motivated to make these improvements.
- Audio problems not related to IP artifacts. Users can adjust the audio volume and tone control of their amplified speakers, use headsets, etc. In short, they may be able to use whatever arrangements they use for other computer-based audio.
- Navigational difficulty or complexity. Here again, improvements would benefit all users.

We are convinced that VoIP companies could address the access requirements of Section 255 “without much difficulty or expense”.

Importance of Standards

VoIP requires successful interoperation between several pairs of technology elements. For example, peer-to-peer VoIP over the Internet depends on the following:

- that the microphone works with the sound card
- that the sound card works with the rest of the PC hardware
- that the PC hardware works with the operating system
- that the operating system works with the VoIP softphone
- that the operating system works with the networking hardware
- that the networking hardware and software work with the access network
- that the access network works with the ISP
- that the ISP works with the Internet backbone
- ... and back again on the receiver's side until the sound card works with the speaker

Obviously, most of these are not specific to VoIP. But the chain of interoperability is vulnerable at all points. Standards strengthen this chain by creating and maintaining public agreements about how the links are to be shaped and joined.

Many variations and different protocols, and few gateway services between them create fragmentation and less usability for all protocols, because you cannot reach everybody from the same service. The telephone network was created when such tendencies were cancelled by regulation for the benefit of voice users who now have a universal voice network. What forces can make VoIP and IP Multimedia the true interoperable super-network giving higher functionality for all regardless of what operator or equipment manufacturer they have?

Even if voice and video is implemented with compatibility according to VoIP standards, the real time text component is not, even when there are well established real time text conversation standards for the major VoIP environments.

In order to gain the described benefits, it requires co-ordination and keeping back the temptation to rush away in various directions with different solutions to similar problems. That is the big challenge! Avoid fragmentation to gain in volume and uniformity to get a snowball effect. How likely is it that we can require multimedia access to emergency services if there are 10 variants of access protocols? How can the positive forces be created that can cause harmonization and concentration on a very small set of protocols?

Luckily, many of the standards organizations concerned with interoperability and communication protocols include accessibility experts. More work needs to be done, of course, but there has already been much progress.

VoIP and the "Accessibility Chain"

Just as the chain of interoperability can be broken by one product that does not comply with standards, the chain of accessibility is vulnerable. The accessibility features built into mainstream products must work with related features in other mainstream products, or with assistive technologies. For example, a VoIP system may offer text communication over IP, but at some point there must be a way to communicate by text to a TTY. This can be built into the VoIP system, or it can be a compatibility feature with assistive technology network products that act as TTY gateways. Either way, there are technical issues to address that are similar to standard interoperability issues; there are also some issues that are unique to accessibility:

- assistive technology firms may lack the technical resources needed to "keep up" with mainstream technological developments
- the assistive technology industry as a whole, being composed of a few small firms, has not developed a robust standards environment for its own products
- given the shortage of standards, mainstream technology designers may develop compatibility with only one model of assistive technology
- mainstream developers may not understand user needs in enough detail because people with disabilities are by definition atypical
- mainstream developers may not understand how people actually use assistive technologies and may focus only on technical compatibility issues

There are probably other issues. The point is that the strength of the VoIP environment may be one of its weaknesses as far as accessibility is concerned.

What is VoIP's strength? A highly decentralized, low-barrier-to-entry industry environment where value can be added at any point encourages rapid innovation in products and services, as well as low prices. In many ways, VoIP may be the most convincing and powerful argument ever made in favor of breaking up telephone monopolies. VoIP potentially enables almost anyone to create a new telecommunications product or service, because it is not necessary to build or invest in a worldwide network. Because developers of those new products and services have low costs, they can focus on smaller markets. One of these markets may be people with disabilities. It is entirely possible that

some companies — maybe even current assistive technology companies — will offer assistive network services for VoIP. That would be a wonderful development.

But it wouldn't essentially solve the accessibility problem, because we'd still have the same issues of the compatibility and interoperability between mainstream and assistive technologies. And a highly decentralized industry means that there is another potential set of problems based on information about accessibility.

The VoIP Information Burden

...on Industry

If we had a telecommunications monopoly where all hardware, software, and networks came through one provider (public or private), information flow about accessibility would be simple. The company would probably have a large accessibility office with good connections with public agencies and regulators, as well as internal working relationships that fostered accessibility improvements. The level of commitment would be clear to everyone involved. This is not to say that all problems would magically disappear, but there would not be much confusion about what the problems were or what the next steps should be.

In fact, that is what we had in some jurisdictions. In California circa 1980, Pacific Bell had a large disability services office, with national support from Long Lines, Bell Labs, Western Electric, and other parts of the Bell System. Pacific Bell was able to assign field engineers to individual customers, who designed, built, and maintained highly customized telephones. Those field engineers were free to inform themselves about the needs of people with disabilities and develop the solutions they wanted. Correspondingly, those solutions were guaranteed to work, because the field engineers were embedded in the one company that was responsible for end-to-end operations.

Today's telecom engineers faced with addressing accessibility have no such luxury. Their companies may compete with each other, making cooperation tentative. Upper management may make decisions on new platforms and standards adoption that swamp or ignore the accessibility issue. Staff churn and corporate re-engineering mean that scarce accessibility wisdom is being discarded. All these result directly from today's competitive telecom environment that otherwise has provided unique benefits.

The bottom line is: what will the information cost be for a VoIP engineer in Company X to learn about an accessibility solution required in a new product? It may require research, attending meetings, reading up on standards, and testing, all the time navigating through a jungle of companies, technologies, and consultants. If that information cost is too high, it will not be paid. For many of the newer, smaller firms — the ones most often pointed to as the engines of VoIP innovation — it may almost always be too high.

...on End Users

Now consider the information burden on consumers with disabilities. That community's innovators and early adopters consist of a few thousand technologically sophisticated,

advocacy-oriented people with disabilities, who know how to use their personal information networks to find out about accessible products. Most of the rest of the disability demographic is lower in income, less well educated, and more socially isolated. To them VoIP (as with much of modern technology) may appear as an impossibly complex maze, navigating through which may lead them to a goal they are not convinced they want. They may have had enough disappointments trying to use technology to lead to a profound sense of pessimism.

Their bottom line is: how far down in the user manual will they have to dive to find something that addresses their disability? What will it take to explain their needs to a customer service representative? Can they stand the need to communicate with a mainstream company and an assistive technology company to solve a problem? Consumers pay information costs as well, and have to make the same kind of "is it worth it?" decisions.

RECOMMENDATIONS:

1. The Commission Should Apply Section 255 to VoIP

We believe that we have made the case:

that VoIP is a telecommunications service
that its implementations currently impose certain accessibility barriers
that those barriers are not being addressed without regulations
that solving those barriers is largely readily achievable
that there is no additional burden placed on the Commission or on industry that could not be met or excused if not readily achievable

We therefore strongly request the Commission to apply Section 255 regulations to all forms of VoIP.

The Commission Should Oversee the Accessibility of VoIP Business Practices

In addition to the technology of VoIP, the business practices that support and extend it may pose access barriers to people with disabilities. Technical support hotlines without TTY access, inaccessible websites that provide the only way of upgrading products, and small-print bills plague consumers with disabilities and exclude them from the use of otherwise accessible products and services. The Commission should make clear to VoIP companies that their Section 255 responsibilities include considering accessibility within their:

- Product development processes
- Consumer information
- Product documentation
- Billing
- Technical support and customer care

- Market research
- Technical trials
- Employee training
- any other elements of their business that involves developing their products or communicating with their customers.

VoIP products and services not directly offered to end users (such as PBXs) should include adequate documentation on how to implement and administer accessibility features, for the benefit of IT managers and system administrators.

The Commission Should Rule on the Section 255 Further Notice of Inquiry

As the Commission promulgated rules for Section 255 of the Telecom Act, it also asked for comment on the accessibility of “IP telephony” as part of a Further Notice of Inquiry (WT Docket No. 96-198). Several comments and replies were received, but the Commission did not initiate a rulemaking.

We ask that the Commission do so, and require Telecom Act compliance for all VoIP products and services, under all Sections.

We understand that there may be reluctance to rule on VoIP because it contains the magic word “Internet”.

Should the Commission decide not to rule on VoIP overall, we believe that the Commission should rule to require that VoIP products and services be accessible. That is, the Commission should apply Section 255 to VoIP products and services.

We believe that the Commission could use two powerful arguments in favor of such regulation:

1. Compelling public interest. As VoIP matures, it is essential that manufacturers and service providers understand the needs of their potential customers with disabilities. Unless this occurs, millions of US citizens will be deprived of the ability to benefit from improved service and lower cost.

2. Precedent under the Modified Final Judgment. During the period of judicial oversight of the breakup of the Bell System, at least one instance of a disability-specific ruling went into effect. In order to offer the Telecommunications Relay Service (TRS), local carriers were permitted to carry TRS calls across LATA boundaries, constituting a “special case” of permitted long distance service.

The Commission Should Defer Enforcement of Certain TTY Compatibility Provisions in Exchange for Forward-looking Industry Activities That Guarantee Functional Equivalence

The Baudot⁷ TTY is still the principal device used by deaf and severely hard of hearing people to communicate over telephone lines. However, other forms and media are undergoing remarkable growth: email, chat, IM, and wireless text have already been adopted by significant percentages of these communities. For example, NECA's TRS Fund projections indicate that IP Relay, only 2 years old, may account for as much as one-third of relay traffic in 2005⁸. Driving this trend are better user interfaces and better integration with mainstream technology users than the TTY can offer. "Former" TTY users now report that they initiate almost all of their "calls" on other media, and keep the TTY around to receive calls or for use in emergencies.

It is safe to say that the TTY remains the device of last resort by a shrinking number of users. It is enshrined in accessibility regulations because there appears no other way to meet the needs of those users. However, all stakeholders quickly or reluctantly agree that the TTY is not optimal, and that other devices and services offer much more functionality and integration.

We believe that stakeholders could agree on a "Migration Path" away from TTYs, and that this Accessible Text Communication Migration Path would involve actions on the part of many parties: advocacy groups, mainstream industry, TRS administrators, TTY manufacturers, and many others.

We also believe that the implementation of the Migration Path would be economically justifiable for both public and private sectors, because it would rationalize a process already taking place, and reduce costs to almost all stakeholders while actually expanding net accessibility.

The Section 255 regulatory framework requires companies to develop directly accessible solutions – accessibility features built into the mainstream product – if readily achievable. Only if direct accessibility is not readily achievable should they seek to make their products compatible with SCPE. Applied to the VoIP-TTY issue, this means that an accessible text communication capability is better than a purely TTY-compatible approach. We see in this framework clear support for a Migration Path strategy under Section 255.

⁷ We use the term "Baudot TTY" to refer both to the device and to its text protocol. It is really the Baudot protocol that is the source of the signal compatibility issues, but we will use the term "TTY" to refer to the Baudot TTY. It is entirely possible that a device marketed to TTY users but using other protocols – even IP – may be offered at some time in the future, and that this device may also be called a "TTY".

⁸ NECA will spend \$34M on interstate TRS and STS. At conventional (11:1) ratios of inter- to intrastate, and ignoring STS, this means that the national TRS market is approximately \$320M. NECA is responsible for both inter- and intrastate IP Relay reimbursement, and it expects to spend \$129M on that item.

We are also firmly convinced that due to the regulatory nature of the TTY issue and the complexity of the economic implications for the various parties, that only the Commission can motivate and manage the Migration Path.

VoIP can form only one aspect of this project. However, VoIP offers a unique “laboratory environment” for regulatory experimentation. We recommend that the Commission defer, for a set amount of time, enforcement of the Section 255 TTY compatibility requirements, under conditions that are intended to rapidly expand the accessibility of mainstream VoIP offerings. The deferments and their conditions should reflect the different implementations of VoIP we described in Table XXX.

Please note that the material below is highly speculative, as is not based on any formal attempt to collect or translate any user needs that this regulatory approach would require. Our recommendation is that the Commission begin the process by convening an appropriate committee of TTY users to identify the exact functional requirements.

TABLE 4: VOIP TTY REGULATORY TREATMENT

	Recommendation	Explanation
Network Segment	Apply and enforce Section 255 requirements for TTY signal compatibility.	TTY users cannot detect or control if a VoIP segment is inserted in their path, so end-to-end TTY performance must be guaranteed.

	Recommendation	Explanation
PBX	<p>Defer enforcement under all the following conditions:</p> <ol style="list-style-type: none"> 1. that TTY-compatible analog RJ-11 adapters are either provided or are available at a nominal price, and that end-to-end TTY calls meet all relevant requirements. 2. that the VoIP PBX includes or is integrated with a well-documented text communication capability for real-time text conversations internal to the PBX. Users must be able to complete any of the following calls: voice-to-voice (conventional VoIP); voice-out-text-in (VCO); text-out-voice-in (HCO); text-to-text. All text must be transmitted character-by-character. 3. that a gateway is available to connect all VoIP PBX lines to the PSTN for the purpose of completing calls to TTYs such that the gateway satisfies all TTY provisions of Section 255. It must interoperate with all relevant emergency services. This gateway may be a part of the PBX, or it may be a public gateway established and maintained at no cost to end users or PBX customers. 	<p>Large-scale VoIP adoption is occurring fastest through the acquisition of VoIP PBX systems by both public and private sector organizations. Users of these systems (employees, students, or members of the public trying to reach the organization by phone) must be guaranteed accessibility.</p> <p>At the same time, the PBX industry has shown a strong response to accessibility demands as expressed in Section 508. Most of the features required here are either already available on most systems, or are certainly “readily achievable”.</p> <p>The one exception is the idea of a public gateway. We believe that if designed correctly, such a gateway (or network of gateways) would be much less expensive than separate TTY gateways established at the PSTN connection point for every PBX.</p>
Hardware (PBX and non-PBX VoIP phones)	Defer enforcement under the condition that a TTY-compatible analog RJ-11 adapter is either provided or is available at a nominal price.	
PBX softphones	Defer enforcement under the condition that the PBX softphone meets the functional requirements listed in the “PBX” section above, including its ability to interoperate with the text gateway.	

	Recommendation	Explanation
Internet peer-to-peer softphones	Defer enforcement under the following conditions: 1. that the software include a text communication capability such that users can complete any of the following calls: voice-to-voice (conventional VoIP); voice-out-text-in (VCO); text-out-voice-in (HCO); text-to-text; and that all text be transmitted character-by-character. 2. that the softphone interoperate with all relevant emergency services. 3. that the softphone interoperate with all public text gateways established for TTY communication as described in the "PBX" section above.	Except for the character-by-character communication mode, these conditions are certainly readily achievable.

We thank the Commission for this opportunity.